

INTERACTION OF REINFORCEMENT SCHEDULES, A BEHAVIORAL PROSTHESIS, AND WORK-RELATED BEHAVIOR IN ADULTS WITH MENTAL RETARDATION

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The effects of variable-interval (VI) and fixed-ratio (FR) schedules of reinforcement for work-related behavior and an organizer for the work materials (behavioral prosthesis) were evaluated with 3 adults with severe or profound mental retardation. The participants had been recommended for study because of high rates of off-task and aberrant behavior in their daily vocational training programs. For 2 participants, VI and FR schedules resulted in the same outcome: more aberrant behavior than on-task and off-task behavior combined. The FR schedule nearly eliminated emission of aberrant and off-task behavior by the 3rd participant. Combining the behavioral prosthesis with FR reinforcement (FR+O) increased the proportion of time spent in on-task behavior by all participants under certain FR schedule parameters. Second-by-second analyses of the observation records revealed that FR schedules reduced off-task and aberrant behavior during work sequences (i.e., ratio runs), and FR+O led to a further reduction of these behaviors during postreinforcement pauses. Overall, the results show how organizer and schedule parameters can be adjusted to produce an optimized balance between productivity and reinforcement while undesirable behavior is minimized.

DESCRIPTORS: reinforcement schedules, work behavior, behavioral prosthesis, aberrant behavior, postreinforcement pause, adults with severe or profound mental retardation

Despite a growing emphasis on providing integrated employment opportunities, a common out-of-residence day activity for adults with developmental disabilities continues to be facility-based employment (Kiernan, Gilmore, & Butterworth, 1997), otherwise known as sheltered employment. In such settings, it is not uncommon to see individuals disengaged from the tasks presented. Their disengagement may take several forms, including seeking attention from staff and peers, wandering within the setting, eloping from the setting, sitting idly, sitting or standing while engaged in repetitive or stereotyped movements, and engaging in

destructive behavior (e.g., self-injury); these behaviors often escalate under prompts to get back to work on the tasks presented.

There are several potentially viable approaches to dealing with these behaviors that may serve an escape or avoidance function. These approaches range from offering a number of activities or tasks from which to choose within the setting (e.g., Romaniuk & Miltenberger, 2001) to offering frequent opportunities to take breaks away from the demands of the tasks (e.g., R. H. Horner & Day, 1991; R. H. Horner, Sprague, O'Brien, & Heathfield, 1990). Another approach is differential reinforcement of behavior alternative to the undesirable behavior. Differential reinforcement has been described in several forms: as reinforcement of other behavior (e.g., Foxx, McMorrow, Fenlon, & Bittle, 1986; Repp, Deitz, & Deitz, 1976), of incompatible behavior (e.g., Barmann, 1980; Favell, 1973), and of an alternative behavior (DRA) (e.g., Azrin, Kaplin, & Foxx, 1973; R. D. Horner, 1980; R. R. Saunders & Saunders, 2000). Reductions in a variety of topographies

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of behavior have been reported for interventions that included differential reinforcement components, including self-injury (e.g., Cowdery, Iwata, & Pace, 1990; Tarpley & Schroeder, 1979), aggression (e.g., Luiselli, 1990), disruptive behaviors (e.g., Cataldo, Ward, Russo, Riordan, & Bennett, 1986; Friman, Barnard, Altman, & Wolf, 1986), and stereotypy (e.g., Jones & Baker, 1989; Repp, Deitz, & Speir, 1974).

The present study was designed to continue research on the effects of a particular permutation of DRA, one in which the alternative behavior to be reinforced is engagement in the task the individual appears to be avoiding. The underlying thesis behind this line of investigation is that what appears to be avoidance often may be a failure of reinforcement schedules to facilitate stimulus control of engagement. In earlier studies, M. D. Saunders, Saunders, and Marquis (1998) and R. R. Saunders and Saunders (2000) found that the use of a device that organized workshop materials into sets of five appeared to improve the effectiveness of a fixed-ratio (FR) reinforcement schedule set at FR 5. Presentation of materials in sets and with an organizer, with reinforcement following functional manipulation of all items in the set, also reduced stereotypic behavior (M. D. Saunders & Saunders, 1997; R. R. Saunders, Saunders, Brewer, & Roach, 1996).

Materials organizers are common in sheltered workshops, either to hold and organize completed product assemblies, for example, or to present materials in a way that allows staff to more easily record production for pay purposes. In our studies, the organizers appeared to serve a prosthetic function (Barrett, 1977) with respect to the effects of reinforcement schedules on learning. The effects observed have similarities with those reported with countdown timers in research on concurrent schedules and special-needs students (Mace, Neef, Shade, & Mauro, 1994; Neef, Mace, Shea, & Shade, 1992) and counters with adults with mental retardation

(Schroeder, 1972). That is, the prostheses led to response patterns closer to what one would expect based on studies with nonhuman animals with similar reinforcement schedules. The prosthetic function of these various organizers and timers can be characterized as one that enhances discrimination of response–event relations (R. R. Saunders & Saunders, 1998) such that a scheduled contingency becomes a functional contingency (Lattal & Poling, 1981). Thus, the present study was designed to examine further the interaction of materials organizers and reinforcement schedules on work-related behavior.

The independent variables in this study were variable-interval (VI) and FR reinforcement schedules and the materials organizer. The primary dependent variables were on-task behavior, aberrant behavior, and off-task behavior categorized and analyzed within two overarching mutually exclusive categories, labeled *work sequences* and *postreinforcement pauses* (PRPs). Thus, the design and data-collection scheme permitted an examination of the influence of reinforcement schedules and the materials organizer on the duration of important event sequences and potentially other dependent variables, such as rate of reinforcement. The research was conducted in a simulated sheltered workshop workstation located in a laboratory, in order to permit unobtrusive live observation from a viewing room with one-way mirrors and videotaping of each session.

METHOD

Participants

Characteristics. Three adult men, John, Sal, and Will, who had been diagnosed with severe (John) or profound mental retardation (as defined by the American Association on Mental Retardation, 1992), participated. All were nonverbal and ambulatory. John and Sal resided at a state-operated institution, and Will lived in a small group home in the community. All participants attended day programs that

focused on training various work skills to adults with developmental disabilities. Agency and university human rights committee approval and guardian consent were obtained for each participant's inclusion in the study. All had been recommended for participation by agency staff because they engaged in low rates of work and high rates of behavior that precluded work, including stereotypy, self-injury, aggression, leaving the workstation, and other off-task behaviors. No formal schedule of reinforcement was employed in their work-training settings. The only scheduled reward for work was a nominal payment of money delivered bi-monthly into their checking accounts. Staff reported that they provided verbal praise for working.

Reinforcer assessment. A test for preferences among potential reinforcers was conducted both prior to training and at the beginning of each experimental session. The potential reinforcers tested included only items that could be delivered within the experimental session and immediately consumed. Thus, food (e.g., potato chips, cheese crackers, Smarties®, M&Ms®, pudding, ice cream) and drink (e.g., fruit punch, cola) items that were recommended by staff as preferred by each participant were offered in a three-choice format in an unsystematic order of presentation and placement in each array. Food or drink items (approximately 3 ml of liquid or 2 g of food) that were consistently chosen by the participants prior to the study were made available for reinforcer preference tests before each experimental session. The daily reinforcer preference test allowed for one selection from among preferred items in a three-choice format. The daily selection became the stimulus delivered as a reinforcer in the session that followed.

Setting and Materials

Experimental sessions were conducted daily at the same time of day, 4 days per week, for 20 min. The simulated sheltered workshop workstation contained a large work table, a

small table, and two chairs. The task selected for this experiment was shredding pieces of paper saved for recycling by research and agency staff. Thus, an Intimus Simplex SE paper-shredding machine was placed next to the participant's chair, and numerous pieces of paper (folded in half for ease of insertion into the shredder) were located in a pile on the large table in front of the participant. A desktop file organizer also was located on the table during some experimental conditions. An organizer allowed up to five pieces of folded paper to be held vertically, one per slot. When the organizer was in use, it was placed where the pile of papers had been, and the pile of papers was placed in front of the experimenter who sat opposite the participant. Food and drink items, a session timer, and extra work materials were placed on the small table. A laptop computer also was present on the small table during VI conditions. A videocamera was placed behind a one-way mirror and was used to record the experimental sessions.

Procedure

Data collection. Data were recorded using a bar code system in which Videx TimeWand II® (Videx, Inc.) scanners with 128K memory were used to scan bar codes. Each behavioral and environmental event to be recorded was assigned a three-digit number, and each number was converted to a bar code (M. D. Saunders, Saunders, & Saunders, 1994). When a bar code was scanned, the behavior or event number, date (year, month, and day), and time (hour, minute, and second) were stored in memory and later transferred to the computer for data processing.

Two overarching mutually exclusive event sequences were recorded: work sequences and PRPs. A work sequence began with the first work-related response (picking up a piece of paper) following reinforcer delivery and ended with the next reinforcer delivery. Thus, a work sequence could include work behavior, off-task behavior, and aberrant behavior that occurred between the first work-related response

following reinforcer delivery and the next reinforcer delivery. A PRP began with reinforcer delivery and ended with the next work-related response (the work-related response that initiated the next work sequence).

Three mutually exclusive classes of behavior were recorded within the two overarching categories: on-task, off-task, and aberrant behavior. On-task behavior included functional manipulation of work materials (working) and consuming the reinforcer following delivery (each with its own bar code). Off-task behavior included standing, walking around the room, and sitting without either work-related responding or reinforcer consumption (each with its own bar code). Aberrant behavior included stereotypy, self-injury, paper tearing, and aggression toward the experimenter (each with its own bar code). In experimental sessions, self-injury, aggression, and paper tearing rarely occurred. When the occasional self-injury was observed, the experimenter blocked or interrupted further self-injury. The experimenter attended to no other form of aberrant behavior.

The observation and recording rules for mutually exclusive event sequences were these: Reinforcer delivery started the PRP, and an on-task work behavior (e.g., picking up a piece of paper) ended the PRP and began recording of a work sequence. For mutually exclusive behaviors, a behavior had to continue for 3 s for recording to shift from the previous behavior to the next behavior. For example, if the code for work had been scanned and the participant stopped manipulating the paper and engaged in stereotypic finger play for 2 s, no change in recording occurred. If the stereotypy continued for another second, however, the code for stereotypy was scanned. Brief pauses (less than 3 s) between work responses while seated, without aberrant behavior, were considered to be work behavior rather than off-task behavior.

Interobserver agreement. Interobserver agreement assessments were conducted by two observers who viewed videotaped sessions

simultaneously for approximately 20% of the experimental sessions and at least once per condition per participant. Interobserver agreement was computed using a computer software program. The program compared the second-by-second record of the primary and reliability observers. The total number of seconds both observers agreed and disagreed for each event sequence and each behavior was calculated. Percentage agreement was calculated by dividing the number of seconds of agreement by that number plus the number of seconds of disagreement and multiplying by 100% for each behavior or event sequence. For the classes of behavior, the software first calculated the reliability percentages for the individual mutually exclusive behaviors (e.g., stereotypy, self-injury) and then collapsed the behaviors that comprised each category and calculated reliability percentages for the classes (e.g., aberrant behavior). Results are presented below for the classes rather than the individual behaviors. Thus, Table 1 shows the reliability percentages for the behavior classes and for the event sequences. Percentages for individual behaviors were similarly high, despite the low frequencies of some, and are available on request.

Condition-change criteria. Condition-change decisions were based on the stability of the on-task behavior class across experimental sessions; no other data were considered. Condition change occurred when one of three criteria was met. Multiple criteria were employed due to prior experience with this population, suggesting that our data would likely be highly variable. The criteria were (a) the vertical distance between the midpercentage on task and middate intersection points from each half of the data set (consisting of at least 5, but no more than 10, sessions) was equal to or less than the length of 20 percentage points on the ordinate. Also, at least 80% of the data points fell within a distance of the length of 10 percentage points on the ordinate from either

Table 1

Interobserver Agreement Percentages for the Mutually Exclusive Behavioral Categories and Mutually Exclusive Event Sequences for Each Participant, with Proportion of Sessions Scored in Parentheses

Category	Definition	John (7/30)	Sal (18/90)	Will (11/46)
Working	Manipulation of work materials in task-advancing manner	96	97	97
Aberrant behavior	Stereotypy, paper tearing, aggression, self-injury	90	95	98
On task	Working, sitting between work responses, consuming the reinforcer	95	95	94
Off task	Aberrant behavior during reinforcer delivery, walking about the room	94	95	95
Work sequence	Interval from picking up first piece of paper after reinforcement to the next reinforcer delivery	81	91	100
Postreinforcement pause	Interval from reinforcement delivery to participant picking up a piece of paper	88	94	100

side of the trend line formed by connecting the intersection points and moving the line so that the same number of points fell above and below the line (adapted from the split-middle method; see Tawney & Gast, 1984, pp. 142–186); (b) the percentages of on-task performance in five consecutive sessions were either all above 90% or all below 10%; and (c) neither of the first two criteria was met during 20 consecutive sessions.

Training procedure. During training, several folded pieces of paper were placed on the table in front of the participant. The experimenter modeled the work response (placing one piece of paper into the shredding machine). Then the participant was prompted (first gesturally, then physically, if necessary) to perform the response. Each work response was reinforced by saying “Good work [participant’s name]” and presenting the preferred drink or food item. Prompts were faded as the participant began to perform the response independently. The schedule of reinforcement was gradually thinned until the rate of reinforcement was approximately one per minute.

Experimental procedure. Following training, the participants were exposed to a series of experimental conditions. Experimental sessions

contained sufficient prompts to produce one contact with the contingencies of reinforcement, if needed; unlimited work materials with which to earn reinforcers; and a schedule of positive reinforcement, with the potential reinforcing stimulus selected daily by the participant. During the experimental sessions, the experimenter began each session by verbally and gesturally indicating to the participant that it was time to start working (i.e., stating “Let’s start working” and pointing to the work materials). If the participant did not start working, the experimenter repeated the prompt. If the participant refrained from working, the experimenter gesturally and physically, if necessary, prompted the participant to complete the number of work responses required for reinforcement (i.e., resulting in reinforcer delivery). Prompted work sequences, reinforcers for prompted work sequences completed, and PRPs following prompted work sequences are included in the results. However, prompting was infrequent, with the overall median at less than one per session.

Experimental Conditions

Each participant was exposed to a series of experimental conditions, the order of which is

shown in Figure 1. The experimental conditions included VI, FR, and FR plus a materials organizer (FR+O). The first experimental condition for all participants was a VI 60-s schedule of reinforcement, in which the reinforcer (selected by the participant before each session) was delivered after the completion of the first work response following the end of a predetermined interval. The VI schedule was administered using a computer program that produced intervals of 30, 45, 60, 75, and 90 s in equal frequency, but were ordered unsystematically via a random number table without restrictions. The program also produced a visual image (filling of a bar with color) on the monitor of a laptop computer that indicated temporal progression through the interval. The laptop screen could be viewed by the experimenter but not by the participant. In VI conditions, the experimenter timed her prompts and assistance to result in the shredding of a piece of paper just as the

scheduled interval was timing out. In the VI 60-s condition, a large stack of papers was placed in front of the participant and the stack was replenished before it was depleted.

An FR condition followed the VI 60-s condition. The initial FR value or parameter was derived from the mean number of pieces of paper shredded per minute during exposure to the VI 60-s schedule. If the average rate was one response per minute in the final session of the VI 60-s condition, an FR 1 schedule was used (John and Sal). A rate of two responses per minute led to an FR 2 schedule for Will. This procedure was based on the premise that, at least initially, the FR would lead to approximately the same rate of reinforcement as did the preceding VI 60-s condition. In FR conditions, prompts were given, as necessary, until the first ratio was fulfilled. As in the preceding conditions, a large stack of papers was placed in front of the participant.

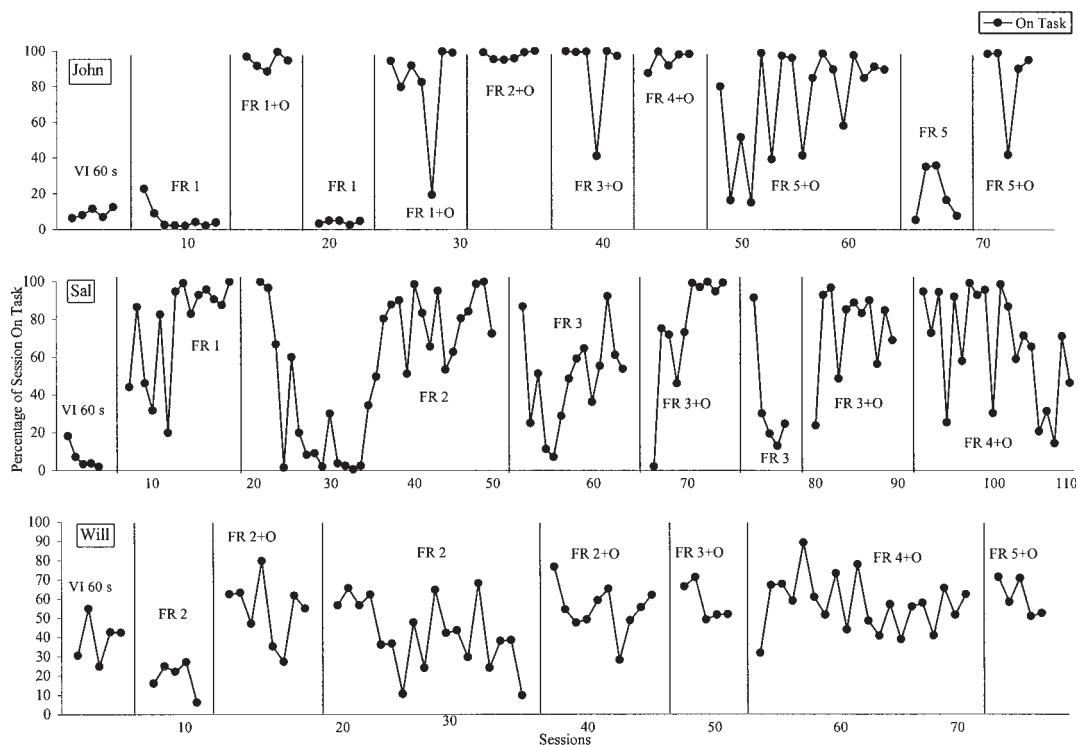


Figure 1. Percentage of each experimental session on task for each participant.

In the next condition for John and Will, an organizer containing the number of slots equal to the size of the ratio (one and two, respectively), rather than the stack of papers, was placed in front of the participant. The organizer had six slots. The extra slots were covered with duct tape such that the organizers had functional slots in numbers equal to the prescribed ratio for each participant. The experimenter placed the organizer, filled with the prescribed number of pieces of paper, in front of the participant. The participant removed pieces of paper one at a time and placed them in the shredding machine. Reinforcement was delivered following the placement of the last piece of paper into the shredding machine. The experimenter refilled the organizer while the participant consumed the food or drink item.

In Sal's FR 1 condition, he showed an increase in work relative to VI. Thus, rather than proceeding immediately to FR 1+O, his schedule was thinned through FR 2 to FR 3 before FR+O was introduced. John and Will showed little change in behavior until the FR+O condition was introduced. With all participants, FR and FR+O conditions were alternated at least twice to verify that the observed condition-related differences in the dependent variables were replicable. Thereafter, the FR+O was progressively thinned to examine the relative allocation of behavior to on-task, off-task, and aberrant behavior at higher ratio values. That is, we adjusted schedule parameters in search of an optimized balance of productivity, reinforcement, and undesirable behavior.

RESULTS

Figure 1 shows the percentage of each session each participant engaged in on-task behavior. The condition-change criteria were applied to these data, and condition change occurred when one of the three criteria was met. One exception was made with Sal in his FR 2 condition. Early in that condition his behavior changed rather dramatically. He became generally unresponsive

to the experimenter and engaged in continuous stereotypy, usually following the first reinforcer delivery. Concurrently, a similar change in behavior was reported by his residential staff. Although Sal often engaged in stereotypy (this was a reason he had been referred as a possible participant), the pattern observed was unusual. Thus, we elected to extend the condition until the residential staff reported that he was behaving more typically. Thereafter (around Session 35), we again applied the criteria until one was met.

Figure 1 shows that only Sal showed an increase in on-task behavior when FR was introduced following the VI 60-s condition. Will engaged in less on-task behavior in the first FR condition than in the preceding VI 60-s condition. Across FR and FR+O conditions at the same ratio value (e.g., FR 3 for Sal), all participants engaged in more on-task behavior when the organizer was employed. John showed the largest differences in on-task behavior between the FR+O and the other schedules. The effects of the organizer or its removal were immediate with each condition change for John. For Will, the effects of introducing the organizer were also large and immediate in both FR 2+O conditions. The effects seen in the FR 3+O conditions for Sal were ultimately large but not immediate.

In the initial FR condition, John's work sequences became shorter, but PRP duration was not affected (Figure 2). Although work sequences became shorter, there was no change in the median number of reinforcers received (Table 2). In contrast, the first FR condition resulted in shorter work sequences and PRPs for Sal. As a result of these changes, the median number of reinforcers received by Sal increased from 1 per session in VI 60 s to 97 per session in FR 1. Gradually thinning the FR schedule had the expected effect of increasing the duration of Sal's work sequences (as more work was required for reinforcement) and also led to increased PRP duration and fewer reinforcers

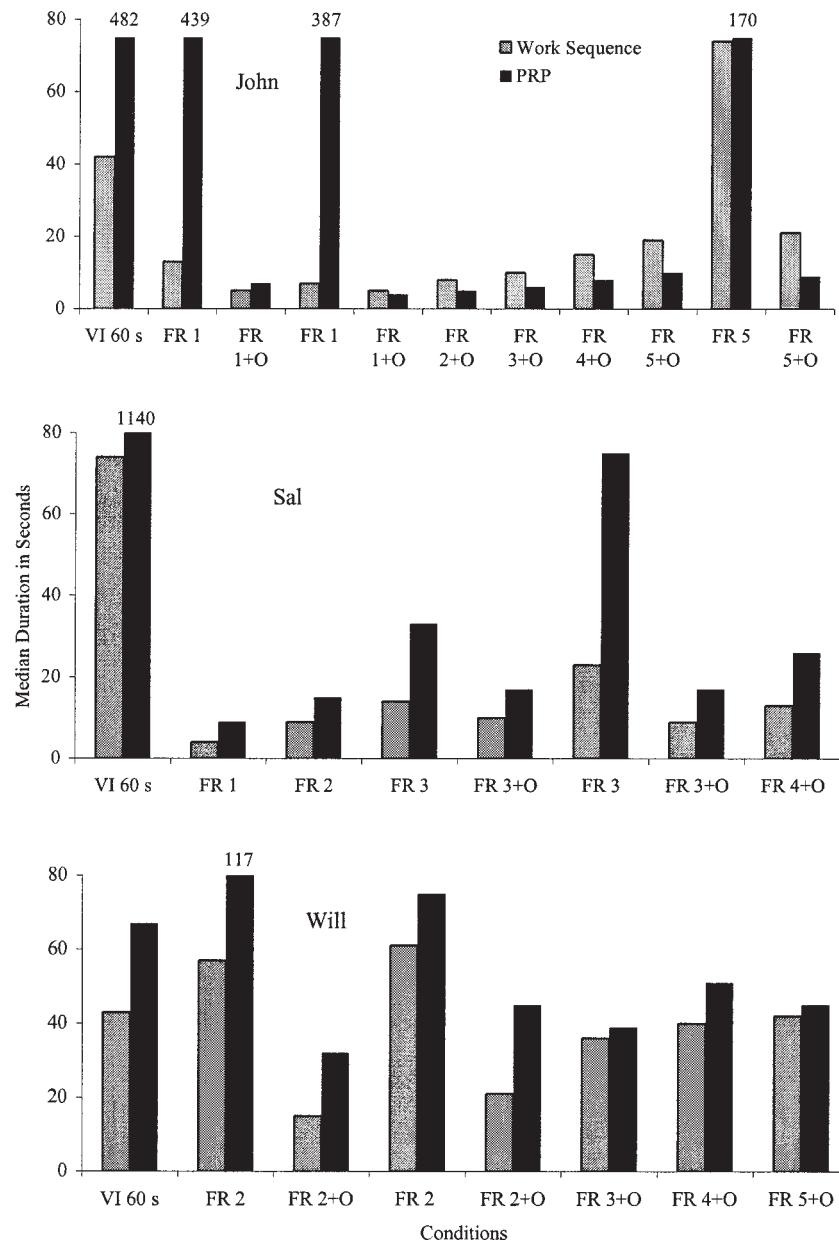


Figure 2. Median duration of the work sequences and PRPs for each condition for each participant.

per session (Table 2). Will's work sequences and PRPs became longer in the first FR condition than had been observed under VI, and the median number of reinforcers received decreased from 11 to 8.

Introduction of FR+O shortened work sequences and PRPs for all participants, relative

to the preceding FR condition, and resulted in an increase in reinforcers received. As shown in Figure 2, the differences between FR with and without an organizer were replicated with respect to work sequence and PRP duration. The data on reinforcers delivered (Table 2) also reflect the stimulus control differences

Table 2

Condition Medians for Percentage of Session Off Task, Percentage of Session Engaged in Aberrant Behavior, and Number of Reinforcers Delivered for John, Sal, and Will

Participant	Schedule	Off task	Aberrant behavior	Reinforcers delivered
John	VI 60 s	15	76	2
	FR 1	19	77	2
	FR 1+O	3	0	95
	FR 1	42	53	3
	FR 1+O	1	2	106
	FR 2+O	0	1	74
	FR 3+O	0	0	60
	FR 4+O	2	1	46
	FR 5+O	3	8	37
	FR 5	20	64	5
Sal	VI 60 s	19	77	1
	FR 1	0	11	97
	FR 2	1	31	49
	FR 3	0	47	26
	FR 3+O	1	14	46
	FR 3	0	70	12
	FR 3+O	1	13	46
	FR 4+O	0	27	26
	VI 60 s	8	54	11
	FR 2	6	73	8
Will	FR 2+O	3	36	27
	FR 2	3	56	9
	FR 2+O	1	43	18
	FR 3+O	3	44	14
	FR 4+O	1	40	14
	FR 5+O	1	40	13

between the two types of FR schedules. Thus, the organizer increased rate of work and rate of reinforcement and decreased pause length following reinforcement; thus, it contributed to the increases in on-task behavior shown in Figure 1. Thinning the FR+O schedule also systematically affected work sequences: Larger work requirements lengthened work sequences and reduced the number of reinforcers received. As the ratio was increased, PRPs also became progressively longer with John and Sal.

On-task, off-task, and aberrant behavior were recorded as mutually exclusive classes of behavior. As the changes in schedules led to the changes in on-task behavior plotted in Figure 1, changes in off-task and aberrant behavior also occurred. These changes are summarized as condition medians in Table 2. Near-zero occurrences of both off-task and aberrant behavior were observed in John's FR+O conditions. Both FR and FR+O for on-task behavior resulted in

decreases in both off-task behavior and aberrant behavior relative to the VI schedule, with larger decreases in off-task and aberrant behavior observed in the FR+O condition than in FR. The same pattern held for Will, but the effects were smaller.

The data in Table 2 show only the overall effects of the schedules on off-task and aberrant behavior. Not yet shown is how the various conditions affected the distribution of off-task and aberrant behavior within work sequences and PRPs. Figure 3 shows the results of a second-by-second analysis of the bar code scan files for the criterion sessions from the first three experimental conditions for John and Will. For Sal, the analysis was conducted with the VI 60-s condition, the first FR 3+O condition, and the FR 3 condition that preceded the first FR 3+O condition. In this analysis, the combined total of off-task and aberrant behavior was calculated for work sequences and PRPs. John's data show

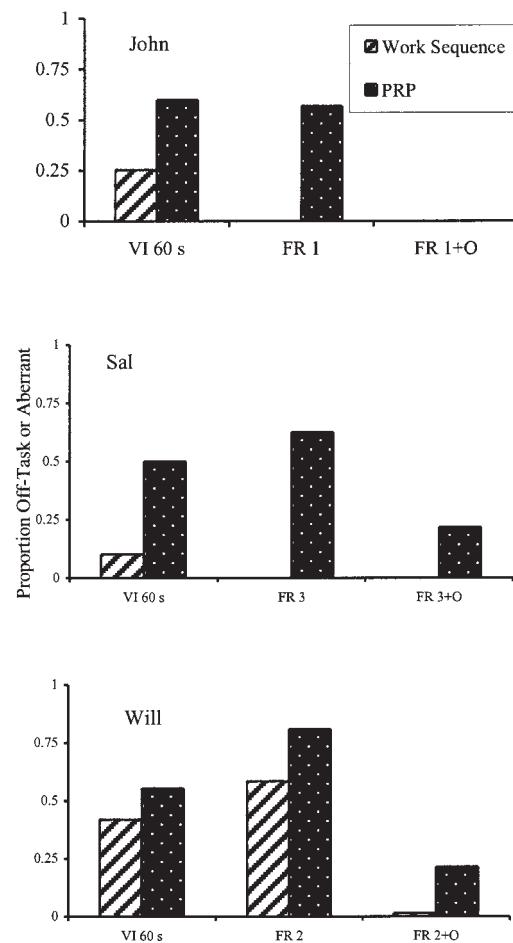


Figure 3. Median proportion of work sequences and PRPs allocated to aberrant and off-task behavior combined for each participant from the condition-change criterion sessions of one example condition of each reinforcement schedule type.

that off-task and aberrant behaviors were absent during sequences in which FR 1 was in place (leading to shorter work sequences, as shown in Figure 2). Furthermore, these behaviors decreased during PRPs when FR 1+O was in place. Sal showed similar but less complete effects. Will's off-task and aberrant behavior increased during the FR 2 schedule relative to VI in both work sequences and PRPs, but decreased to near-zero levels with FR 2+O during both work sequences and PRPs, similar to Sal and John.

DISCUSSION

For all participants, under VI conditions, aberrant behavior occurred more often than off-task and on-task behavior combined. Further, more time was spent in off-task behaviors during PRPs than during work sequences. FR produced less allocation to off-task and aberrant behaviors in work sequences, relative to VI, for 2 participants. For all participants, introduction of FR+O was associated with reductions in off-task and aberrant behaviors in work sequences and PRPs, relative to VI and FR. FR+O also led to the highest number of reinforcers delivered per session. The higher rate of reinforcement contributed to the maintenance of high proportions of each session being distributed to PRPs, but PRPs became shorter. Thus, all participants returned to work most quickly following reinforcer delivery under FR+O schedules. One explanation for this finding is that the experimenter's filling of the organizer acted as a visual cue to begin work, but subtle cues to return to work do not explain the reduction in the durations of work sequences because prompts to work were not given beyond delivery of the first reinforcer in each session.

One possible explanation for the change in work-sequence durations is that the organizer may have signaled the delivery of reinforcement in a manner similar to the use of countdown timers in prior research with VI schedules. Each shredded piece of paper emptied one slot in the organizer with effects similar to completing steps in a response chain. A response chain may be summarized as follows: Responding to the first stimulus in the chain changes the exteroceptive properties of that stimulus. That stimulus becomes the discriminative stimulus for the second response in the chain. Responding in the presence of the second stimulus produces a third stimulus, and so forth, until responding in the presence of the final stimulus is reinforced (Ferster & Skinner, 1957). With the organizer, each piece of paper shredded left one additional slot in the

organizer empty. In contrast, shredding under the FR without organizer may have not changed the exteroceptive properties of the stimulus array (i.e., the large pile of papers). Thus, without the organizer, the effects of responding early in the work sequence were perhaps not discriminated from the response later in the chain that was followed by reinforcement. An interesting experiment for future research would be comparison under FR conditions of the large stack of papers with a small stack of papers (equal in number to the ratio), but without the organizer.

The present study employed schedules of reinforcement with parameters difficult to sustain in typical applied settings, such as sheltered workshops, but the results may suggest a more practical approach that can be tested in future research. We usually envision simple chains as being a sequence of topographically different responses (e.g., putting on sock, putting on shoe, tying shoelace). In the present study, the work responses were topographically similar. Thus, we might alternatively view the FR+O as producing a sequence of simple schedules. These schedules are often referred to as second-order schedules (Kelleher, 1966). One variant, a second-order chained schedule, is one in which responding in each component produces a stimulus with different exteroceptive properties, but within components, responses have the same topography. A second-order chained schedule (e.g., chain FR 3 FR 1) could be arranged by having each FR 1 (e.g., one response) component end with the flashing of a different-colored light. By analogy, as the organizer was emptied one piece of paper at a time, each topographically similar shredding response produced a different stimulus array in the organizer. Prior research with nonhuman animals has shown that chained schedules can be arranged to produce response rates higher than those produced with simple schedules with large response requirements and higher than those produced by other types of second-order

schedules. More research needs to be conducted, but the orderliness of the present data suggests that effective schedules that also are sustainable by staff could be arranged (e.g., chain FR 5 FR 10).

In addition to decreasing work-sequence durations, FR+O consistently reduced off-task and aberrant behavior in PRPs, both by shortening the PRPs relative to both VI and FR without the organizer and by reducing these behaviors during the shortened PRPs. The patterns of behavioral allocation to off-task and aberrant behaviors under VI and FR without the organizer reported here are similar to previously reported results. Wieseler, Hanson, Chamberlain, and Thompson (1988) reported relatively low work rates and high rates of stereotypy under a fixed-interval schedule of reinforcement. As the duration of the interval increased, stereotypy increased in the same proportion. The authors hypothesized that stereotypy was an adjunctive behavior. Adjunctive behaviors are those that are not specified by the reinforcement contingency but are entrained by reinforcement delivery. With the present participants, stereotypy was the most common aberrant behavior, and stereotypy was prevalent following reinforcer delivery under VI and FR schedules (except for Sal in FR 1). The optimal window for adjunctive behaviors is estimated at 2 to 3 min (Falk, 1971), and some of our participants showed prolongation of the PRP well into and beyond 2 to 3 min under VI conditions.

This study occurred in a carefully controlled setting so that reinforcement could be delivered expeditiously and so that responses alternative to work would be limited to a small set of off-task and aberrant behaviors. Work behavior is more commonly studied in typical vocational settings in which individuals have more distractions than we permitted. Our controlled environment eliminated or minimized these responses during the experimental sessions. A controlled setting also permitted the collection

of data required for a precise analysis of the interaction of variables such as the PRP and aberrant behavior. Nevertheless, the effects of the organizer should be influential in more typical settings, particularly when sustainable reinforcement schedules can be employed.

The design of the current study left two questions unanswered. First, all participants met a condition-change criterion in the minimum number of sessions possible in the VI condition. It is possible that the results do not reflect what the VI schedule would have produced if exposure were extended beyond five sessions. The second question is whether, for John and Will, the results of the first FR condition were less a function of schedule parameters and more a function of a continuation of the inexperience of the participants in the task and with the schedules. Another alternative explanation is that their brief history of low-rate responding under VI influenced their responding under FR during the relatively few sessions of FR required to meet a condition-change criterion. Future studies might be improved by providing a longer exposure to whatever initial schedule is evaluated. Alternatively, reexposure to the initial schedule (VI in this study) might be included following tests of other schedules and the organizer. That said, the fact that schedule control was reduced for John and Sal when FR+O was followed by a return to FR suggests that the data from each schedule type reflect replicable differences in schedule control that were not a function of degree of experience with the task or a function of schedule-history effects.

The purpose of this study was to continue to investigate how one might increase engagement in tasks that individuals with developmental disabilities may avoid in day-activity settings. Offering other activity choices, both inside and outside the setting, may be options for some. When that is not the case, however, the present data suggest a feasible alternative—adjusting environmental variables that lead to an increase

in reinforcement-schedule control over engagement in the previously avoided activity. Overall, the results show how adjusting organizer and schedule parameters may produce an optimized balance between productivity and reinforcement for the employee while undesirable behavior in the workplace is minimized.

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STUDY QUESTIONS

1. The authors suggested that what appears to be avoidance often may be a failure of reinforcement schedules to facilitate stimulus control over engagement. Under what conditions might these accounts of behavior *not* be mutually exclusive?
2. Describe the dependent variables.
3. Given the temporal requirements for scoring, describe a condition under which some significant responses may have gone unrecorded.
4. Why do you suppose the authors selected VI and FR schedules of reinforcement for evaluation, and how were the initial VI and FR values determined?
5. Describe how the work organizer was used when it was present.
6. Summarize the results in terms of effects observed on (a) work sequences, (b) PRP, and (c) aberrant behavior.
7. What additional experimental conditions may have been helpful in determining whether the consequences delivered functioned as reinforcers?
8. What two behavioral mechanisms did the authors suggest to account for effects observed during the organizer condition? What additional function might the organizer have served?

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